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A NEW-TYPE GEOPHYSICAL EFFECT CONNECTED WITH THE SOLAR FLARE OF 3 JULY 1957 AND OBSERVED AT THE DUMONT D'URVILLE ANTARCTICA STATION

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[redacted]

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by André Lebeau and
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The 3 July 1957 flare and the associated type-IV radioburst constitute two distinct events : the first reached its maximum at 07 40 hours UT, the second, which is also the most intense — at 08 40 hours UT. This structure clearly appears on the pictures obtained with the aid of a spectroheliograph of the Meudon Observatory [1], on the light curve derived from it (curve 1) and on the recording at the Nera radioastronomical station of the intensity of the solar emission in the frequency of 2 980 mc/s (curve 2).

Four hours after commencement of this event we were witnesses of an unusual event at the Dumont d'Urville station (geomagnetic coordinates: 230° 9' E; 75° 6' S).

At this epoch, the station's magnetographs are in continous operation, the ionosphere soundings are conducted every hour on the hour and at each quarter of the hour before and after.

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* Note presented by M. Jean Coulomb : Un évenement géophysique d'un type nouveau lié a l'éruption solaire du 3 juillet 1957 et observé a la Station antarctique Dumont d'Urville.

[redacted]

In spite of unfavorable circumstances, a photoelectric photometer was finally in operation on that day. The sky was uniformly overcast and the luminous intensity originating from various parts of the sky was thus integrated.

Curves 3, 4 and 5 (see Figure next page) show the aspect of the phenomenon observed against the sky's luminous intensity (3 914 Å band of N_2^+ IN), the North-South component of the geomagnetic field and the minimum frequency observable by ionosphere soundings, whose increase is characteristic of the increase of ionization in the D-region.

At 11 43 hrs UT the intensity of the line 3 914 Å began to increase, being multiplied 8 times in less than 5 minutes. At the same time, a strong geomagnetic disturbance took place, entailing a decrease by 325 γ of the North-South component, and there appeared an anomalous ionospheric absorption. At 11 56 hrs the luminous intensity returned to its normal level and the magnetic disturbance disappeared. The minimum frequency was still high, but it returned to its initial value at 12 15 hours. A new rise started on the photometer at 12 30 hours and a maximum of about 20 times the basic level has been reached at about 12 50 hours. Disregarding the possible saturation of the photomultiplier, and assuming the emission distributed uniformly about all the sky, this second maximum corresponds to an intensity of $5 \cdot 10^4$ rayleighs, value only approached twice in the course of intense aurorae, during the some 500 hours of photometrical observations obtained in 1957 at the d'Urville station. During the same lapse of time the North-South component decreased by 492 γ and the minimum frequency reached 2.6 mc/s.

The return to quiet state is effected very rapidly and at 13 00 hours all abnormal manifestations disappeared.

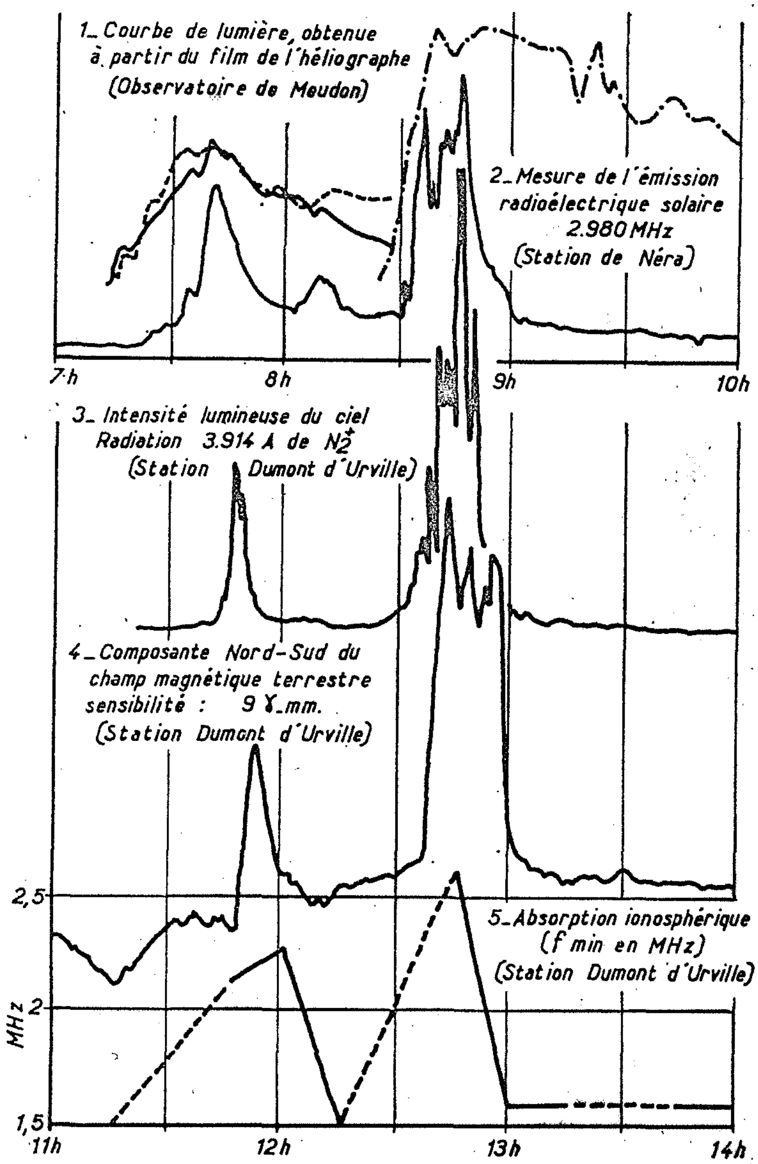

FIGURE CAPTIONS.

1. Light curve obtained after the heliograph film at the Meudon Observatory.

2. Measurement of solar radioelectric emission at 2 980 mc/s at the Nera Station.

3. Luminous intensity of the sky. 3 914 Å emission of N_2^+. at the Dumont d'Urville station.

4. North-South component of the Earth's magnetic field. Sensitivity : 9 γ mm. (D. d'Urville Station)

5. Ionospherical absorption (f min in mc/s). at Dumont d'Urville Station.

However, the
established itself at the d'Urville station and the blackout was total through July 4 at 08 00 hours UT. Finally two world sudden commencements took place at one hour interval, respectively on 4 July at 23 42 hours and on the 5th at 00 42 hours.

The similitude of curves concerning the solar event and those registered at d'Urville, the identity of time span between the maxima, the relative intensities of these maxima lead to believe that a very intense arrival of hard particles emitted by the Sun during the flare was observed at the d'Urville station. The narrow localisation of this phenomenon is asserted by the auroral and magnetic observations of the neighboring stations having showed nothing exceptional.

To explain the whole of observations it is seems necessary to admit that an intense flux of solar particles was emitted at the moment of the two flare maxima. These particles have freely propagated between the Sun and the Earth, and, for a defined energy range, they were focused by the terrestrial magnetic field into one or several narrowly-outlined zones [2].

The time of Sun-Earth propagation has been of 4 hrs 2 ± 5 m. which would correspond for particles propagating in a straight line and constant velocity to a speed $v = 1.03 \cdot 10^9$ cm/s. Electrons having such speed could reach neither the latitude nor the altitude required to explain the optical and ionospheric effects observed. To the contrary, a flux of protons offers satisfactory characteristics.

This has been obviously a phenomenon of a new type, differing namely from those producing the known effects designated as P.C.A. and P.C.G. [3, 4, 5, 6]. In particular it is for the first time, as far as we know, that a magnetic disturbance could have been directly ascribed to solar proton arrival. The intensity of proton bombardment revealed by optical observations and the narrow localization of the phenomenon may render account of that peculiarity.

G. Olivieri, M. Moutadian and M. Pick of the Meudon Observatory, S. Cartron of Ionospheric Research Group and R, Schlich of the Institute of Physics of the Globe have assisted us in the interpretation of data presented in this paper.

*** THE END ***

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